Section 8 - User Interface

This section describes the following Workstation user interfaces.

- Control Panel Processor
- Infrared Remote Control and Sensor
- Keyboard
- Touch Screen
- X-Ray On Indicator

The section is organized as follows:

Control Panel Processor 8-3
Location 8-3
Circuit Description 8-4
Microcontroller 8-4
Microcontroller Reset and Watchdog Circuitry 8-4
Address Decoding 8-4
Diagnostic LEDs 8-5
Infrared Remote Input and Power Supply 8-5
Serial Communications with System Interface PCB 8-5
Test Points 8-6
Circuit Breakers and Fuses 8-6
Troubleshooting 8-7
Removal and Replacement 8-7

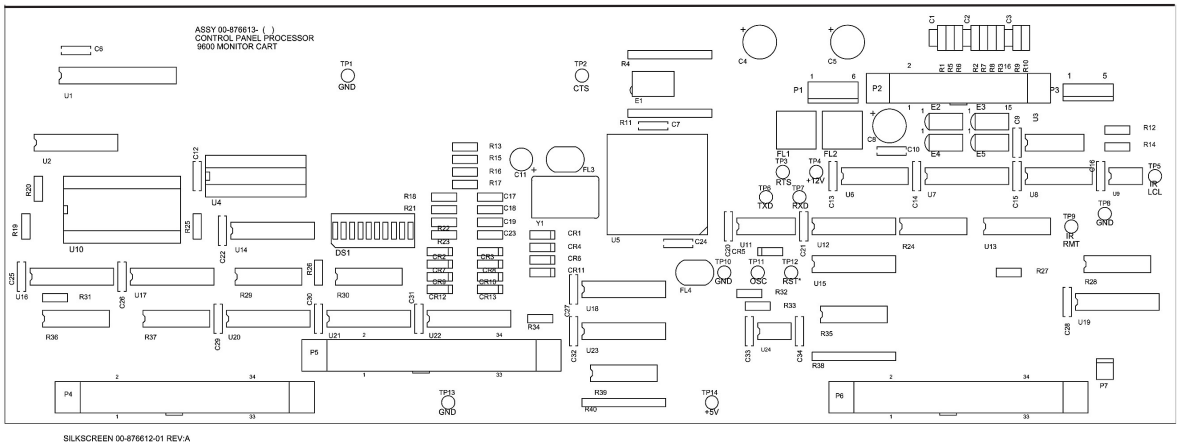
Infrared Remote Control and Sensor 8-8
Location 8-8
Circuit Description 8-8
Test Points....8-9
Circuit Breakers and Fuses 8-9
Troubleshooting....8-9
Removal and Replacement 8-10
Keyboard 8-11
Location 8-11
Circuit Description 8-11
Test Points....8-11
Circuit Breakers and Fuses 8-11
Troubleshooting....8-11
Removal and Replacement 8-12
Touch Screen 8-12
Location 8-13
Circuit Description 8-13
Test Points....8-13
Circuit Breakers and Fuses 8-13
Troubleshooting....8-13
Removal and Replacement 8-14
X-Ray on Indicator 8-16
Location 8-16
Circuit Description 8-17
Test Points....8-17
Circuit Breakers and Fuses 8-17
Troubleshooting....8-17
Removal and Replacement 8-18

Control Panel Processor

The Control Panel Processor (CPP) scans for key closures on the Keyboard and reports these closures to the **System Interface PCB** for further processing. The CPP also responds to commands from the System Interface PCB to light Keyboard LEDs.

Location

The Control Panel Processor PCB is located directly beneath the Keyboard. The following is an assembly drawing of the board.



Control Panel Processor PCB

Circuit Description

Please refer to **Control Panel Processor Schematic Diagram 00-876611** while reading the following description.

Microcontroller

U5 is a CHMOS 16-bit 80C196KC microcontroller. Y1 clocks the chip at 12 MHz. The microcontroller has four 8-bit ports (P0 through P3) and eight high speed serial ports (HSI0 - HSI3 and HSO0 - HSO5).

Port HSO0 and its inverse (U11-F) drive two inputs on U13, which is a four-channel push-pull driver. This chip provides a differential 12 Volts DC to operate a piezo alarm connected to P7. Software toggles this port to generate tones of variable frequency and duration. The alarm device can deliver between 60 and 80 dB from 200 Hz to 2 kHz. Volume is not adjustable.

Microcontroller Reset and Watchdog Circuitry

Reset circuitry consists of U24, pullups R32 and R33, two Schmidt trigger inverters on U2, and schottky diode CR1. U24 is a power-up reset generator and watchdog timer. The reset output of this device is held low when the +5 volt supply is less than 4.65 Volts and remains low for 50 ms after the supply rises above 4.65 Volts. This ensures a clean reset signal during power failure and brownout conditions. The power fail feature of U24 is not used.

To reset the microcontroller its reset pin (U5-16) must be low for at least 2.7 µs after the power supply stabilizes. The Schmitt trigger inverter provides a clean transition for the reset signal. The reset signal is also applied to U4 to disable all address decoding.

The watchdog circuit is driven from microcontroller's port 1, bit 1 into pin 6 of U24. This line must toggle continuously and faster than every 1.6 seconds to prevent a reset.

Address Decoding

U2, U14 and U4 provide address decoding of the microcontroller bus.

Diagnostic LEDs

DS1 is a 10-segment LED bargraph that software uses to display status information. Its segments have the following meanings:

DS1-1 lights when you press buttons on the icon keyboard.

DS1-2 lights when you press buttons on the text keyboard.

DS1-3 is not used.

DS1-4 is not used.

DS1-5 lights when IR data from the remote control is being received.

DS1-6 lights when the audible alarm is on.

DS1-7 lights when the Control Panel Processor PCB receives data from the **System Interface PCB**.

DS1-8 lights when the Control Panel Processor PCB sends data to the System Interface PCB.

DS1-9 is not used.

DS1-10 blinks when the microcontroller is running.

Infrared Remote Input and Power Supply

Optoisolator U9-7 generates a pulse train in response to actuation of the remote control. U8-5 is always high, enabling the pulse train through U3. The pulse train generates interrupts on P2.2 of the microcontroller.

P3 supplies +12 Volts to the IR receiver, which regulates it down to +5 Volts to operate the IR receiver circuitry.

Serial Communications with System Interface PCB

The Control Panel Processor uses RS232 serial communications to communicate with the System Interface PCB. The microcontroller uses a MAX233 line driver/receiver (U7) to communicate over J2 with an identical MAX233 on the System Interface PCB. The communications rate is 9600 baud.

Test Points

TP1 Ground
TP2 Clear to Send
TP3 Request to Send
TP4 +12 Volts
TP5 Pulses from IR Remote
TP6 Transmit Data
TP7 Receive Data
TP8 Ground
TP9 +5 Volts (U8 is not used)
TP10 Ground
TP11 12 MHz microcontroller clock
TP12 Watchdog reset
TP13 Ground
TP14 + 5 Volts

Circuit Breakers and Fuses

There are no circuit breakers or fuses on the Control Panel Processor PCB.

Troubleshooting

The fastest way to troubleshoot the Control Panel Processor PCB is to monitor its **Diagnostic LEDs**. The following general guidelines also apply.

- When keyboard or diagnostic LEDs fail to operate, look for failure in the associated LED driver.
- If the infrared remote doesn't work and the batteries are OK, look for failure of U8 or U9.
- If the system doesn't respond to key closures or responds erroneously, look for failure in row output or column input circuitry. Bad pullup resistors on these lines can also cause incorrectly decoded key closures.

Removal and Replacement

1. Turn off Workstation and remove its plug from the AC outlet.
2. Remove the **Keyboard** from the Workstation.
3. Disconnect all cabling from the Control Panel Processor PCB. Tag the cables to permit easier reinstallation.
4. Remove the mounting hardware and lift the Control Panel Processor from the Workstation.
5. Place removed Control Panel Processor PCB in antistatic bag.
6. Install replacement Control Panel Processor in Workstation and secure mounting hardware.
7. Connect cabling you removed in step 3.
8. Install Keyboard in Workstation.
9. Power up system and check for proper operation.

Infrared Remote Control and Sensor

The Infrared Remote subsystem consists of a battery-operated, handheld remote control and an infrared receiver that mounts between the monitors.

Location

On the remote control and receiver assembly.

Circuit Description

Please refer to **Infrared Receiver Schematic 00-879378** while reading the following information.

The remote control transmitter generates a 940 nm invisible light beam that strikes the photodiodes on the IR receiver PCB. U4 is a preamplifier that passes the signal though a 53.3 kHz bandpass filter consisting of L1 and C2. U2 amplifies the signal further and passes it though ambient noise filter U3. U1, Q1 and Q2 then demodulate the signal and pass it to the Control Panel Processor PCB.

The Infrared Receiver is powered by +12 Volts from the Control Panel Processor PCB.

Test Points

There are no test points on either the transmitter or receiver PCB.

Circuit Breakers and Fuses

There are no circuit breakers or fuses on either the transmitter or receiver PCB.

Troubleshooting

If the IR Remote Control doesn't work, follow these steps:

1. Operate the IR transmitter near a standard broadcast AM radio receiver tuned to an unused frequency with the volume up. If things are working normally, you should be able to hear the pulses as you press each transmitter button.
2. If step 1 produces negative results, check the batteries in the handheld transmitter. It requires three AAA alkaline cells. If replacing the batteries does not bring the transmitter to life, replace the transmitter.
3. Once you are sure the transmitter works, check DS1-5 on the Control Panel Processor PCB as you press buttons on the Infrared Remote. The LED should light each time you press a button. If DS1-5 doesn't light, replace the IR Receiver assembly.

Removal and Replacement

Follow these steps to replace the IR Receiver:

1. Turn off the Workstation and disconnect it from the AC outlet.
2. Remove the **Monitor Cover**.
3. Remove the torx screw that secures the IR Receiver assembly to the monitor bezel.
4. Disconnect the A31J1 from the IR Receiver assembly.
5. Install A31J1 on replacement IR Receiver assembly.
6. Mount replacement IR Receiver using torx screw you removed in step 3.
7. Turn on Workstation and check IR Remote for proper operation.
8. Install Monitor Cover.

Keyboard

The following paragraphs describe the Workstation's keyboard.

Location

The keyboard is located directly beneath the High Resolution monitors on the Workstation.

Circuit Description

The keyboard is a simple switch matrix with no active components. It consists of a PCB that mounts underneath a flexible, fluid-resistant membrane embedded with contactors that close switch contacts on the PCB when the operator presses the keys. Two ribbon cables connect the keyboard PCB to scanning circuitry on the **Control Panel Processor PCB**.

Test Points

No test points are available on the Keyboard PCB.

Circuit Breakers and Fuses

There are no circuit breakers or fuses on the Keyboard PCB.

Troubleshooting

Most Keyboard problems are associated with damage to the Keyboard membrane. A damaged membrane allows contamination from moisture or dirt to enter the contacts and cause unreliable operation. The solution to this is to remove the damaged membrane, clean the Keyboard PCB contact areas, and install a replacement membrane.

Removal and Replacement

Follow these steps to replace the keyboard membrane:

1. Turn off Workstation and disconnect it from AC outlet.
2. Remove six screws from bottom of Keyboard that secure it to Workstation chassis.
3. Gently pull Keyboard toward you. When Keyboard clears Workstation, turn it over and disconnect the two ribbon cables. Also remove the nut that secures the green and yellow ground wire to the Keyboard and disconnect the wire. Tag the ribbon cable connectors so you don't mix them up later.
4. Set the Keyboard upside down on a flat surface.
5. Remove 18 torx screws and washers to free Keyboard membrane and PCB from Keyboard bezel. Lift membrane and PCB away from bezel.
6. Align fingers on replacement membrane with holes in Keyboard PCB and gently press the membrane into place over the Keyboard PCB.
7. Align Keyboard and membrane with mounting holes in bezel and install screws/washers you removed in step 5. Secure the screws carefully and uniformly.
8. Install ribbon cables you removed in step 3. Install ground wire and secure nut.
9. Set keyboard in place on Workstation and install six screws you removed in step 2. Secure the screws.
10. Turn on Workstation and check Keyboard for proper operation.

Touch Screen

The right-hand monitor has an array of infrared LEDs and a corresponding array of phototransistors surrounding the CRT face that detects a finger touching or nearly touching the CRT, calculates the position of the finger, and sends this information back to the **System Interface PCB**. The operator uses this touch screen feature in conjunction with displayed software screens to make mode or function selections during Workstation operation.

Location

On the Touch Screen Assembly.

Circuit Description

The Touch Screen Assembly is an off-the-shelf item and no detailed circuit description is available for it.

The Touch Screen Assembly receives +12 Volts and +5 Volts from the **DC Distribution PCB**. It communicates with the System Interface PCB over a simple three-wire RS232 interface.

Test Points

There are no test points available on the Touch Screen interface, but you can observe RS232 signals and check power supply voltages on P1, which is available under the monitor bezel behind the right monitor. You have to remove the **Monitor Cover** to access this connector.

Circuit Breakers and Fuses

The Touch Screen Assembly has no circuit breakers or fuses.

Troubleshooting

If the Touch Screen Assembly does not produce RS232 activity when DC power is applied to it, replace the Touch Screen Assembly. You should be able to observe this activity on P1-2. Set your oscilloscope sensitivity for 5 Volts/division and the sweep at 1 millisecond per division.

Removal and Replacement

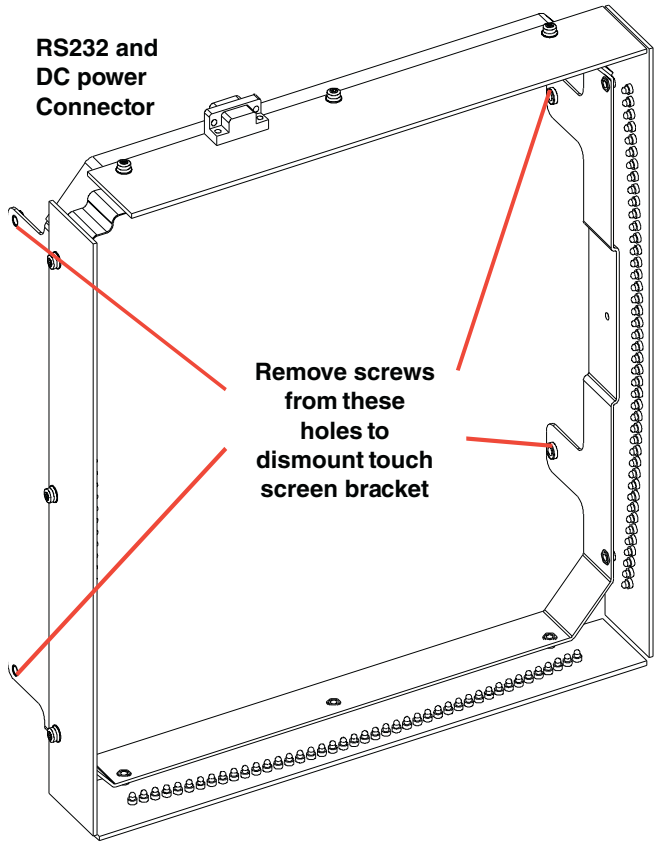
Follow these steps to replace the Touch Screen Assembly:

1. Turn off Workstation and disconnect its power plug from the AC outlet.
2. Remove **Monitor Cover**.
3. Remove 12 torx screws to loosen bezel from bezel frame.
4. Carefully remove X-Ray On light and IR Receiver assemblies from bezel. Set bezel aside.

***CAUTION**: Avoid shorting any electrical contacts in the next step.*

5. Use masking tape or similar non-conductive tape to secure X-Ray On light and IR Receiver Assembly to bezel frame. Be careful not to short out electrical contacts on either component.
6. Carefully mark position of left Monitor on Workstation chassis so you can accurately reposition Monitor later.

7. Loosen three screws that secure left Monitor to Workstation chassis. Carefully slide left Monitor back far enough to give access to Touch Screen Mounting Bracket screws that are located between the two monitors. (See following illustration)



Touch Screen Electronics and Mounting Bracket

8. Remove four torx screws that secure Touch Screen Mounting Bracket to right Monitor.
9. Disconnect serial cable from top of Touch Screen Assembly and remove Touch Screen Assembly from right monitor. Place removed Touch Screen Assembly in antistatic container.
10. Connect serial cable to replacement Touch Screen Assembly.
11. Mount replacement Touch Screen Assembly to right Monitor chassis using screws you removed in step 8.
12. Temporarily move left monitor back into position. Turn on Workstation and test Touch Screen assembly for proper operation.
13. When Touch Screen works properly, turn off Workstation and remove its AC plug from AC outlet.
14. Carefully move left monitor into position you marked in step 6. Secure three left Monitor mounting screws.
15. Mount X-Ray On light and IR Receiver to Monitor bezel.
16. Mount Monitor bezel to bezel frame using 12 screws you removed in step 3.
17. Install Monitor Rear Cover you removed in step 2 and return Workstation to service.

X-Ray on Indicator

The X-Ray On indicator lights any time the system generates X-rays. The indicator contains an array of six LEDs driven by a signal from the System Interface PCB.

Location

The X-Ray On indicator is located on top the left Monitor's bezel.

Circuit Description

The X-Ray On indicator is an array of six bipolar LEDs with current limiting resistance built in. Bipolar LEDs can be powered by DC without regard to polarity or by AC. The Workstation powers the indicator with a +5 VDC signal from the **System Interface PCB**.

LED arrays like this one are extremely reliable, lasting over 100,000 hours in normal use.

Test Points

None available.

Circuit Breakers and Fuses

None.

Troubleshooting

If the X-Ray On indicator doesn't work, and 5 Volts DC is present at the indicator when the system makes X-rays, replace the indicator. You can replace the LED array assembly inside the lamp or the entire indicator assembly.

Removal and Replacement

To replace the LED array inside the X-Ray On indicator assembly, just remove the lens from the indicator, lift out the old array, and put in a new one. To replace the entire X-Ray On indicator assembly, follow these steps:

1. Turn off Workstation, and remove its AC plug from the AC outlet.
2. Remove **Monitor cover**.
3. Remove mounting screws from monitor bezel and move loosened bezel forward to get access to terminals and lock ring on bottom end of indicator assembly.
4. Remove wires from indicator terminals.
5. Remove lock ring from indicator by twisting it counterclockwise.
6. Lift old indicator from bezel and install new one. Secure lock ring.
7. Connect two wires you removed in step 4. There is no polarity to worry about.
8. Mount bezel to bezel frame and secure mounting screws.
9. Turn on Workstation and check X-Ray On indicator for proper operation.
10. Install Monitor cover.